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TASK 5
PHASE I
PROGRESS REPORT #1 - MODEL C

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RD 54
TASK 5
PHASE I
PROGRESS REPORT #1 - MODEL C

30 DECEMBER 1955

OBJECTIVE:

To study and evaluate factors and components involved in the design of a miniature infrared voice communicator. To plan and schedule the complete task 5 for the production of Model C equipment.

DATA:

General Planning.

A schedule has been prepared to outline the overall planning of the project. The dates are approximate, of course, but represent the target dates at this time. The principal schedule dates are given below.

Study phase	21 November 1955 to about 23 January 1956
Study phase conference	During week of 23 January 1956
Preliminary design	23 January 1956 to 1 March 1956
Design and construct two design approval models	1 March 1956 to 1 June 1956
Customer evaluation	1 June 1956 to 15 June 1956
Design conference	15 June 1956
Development changes and construct 4 models	15 June 1956 to 1 October 1956
Deliver 20 copies of Operating Instructions	1 October 1956
Finish technical manual, final report, and manufacturing drawings	21 November 1956

Specifications.

Several tentative specifications have been set up on the basis of the proposal and previous discussions with customer personnel. These are subject to change as the study and later phases progress.

1. Range:

Average clear weather night range is to be in excess of one land mile when used with a Model B equipment. Range is to be greater than 1/4 land mile when used with another Model C unit. The daylight range of the equipment is to be as close to the night range as possible and preferably will at least meet the above minimum range requirements. The range is to be made as great as practicable within the size requirements of the equipment.

2. Case Size:

A maximum case size of 6 inches long by 12 inches perimeter has been set. A probable shape will give dimensions 1-1/2" x 4-1/2" x 6". No weight specification has been set. Lightweight materials will be used where possible and the small case size will prevent excessive weight.

3. Batteries:

A life of one to two hours at 70°F in transmit condition is required. Batteries may be dry cells of various types such as mercury cells, etc., or miniature storage cells.

4. Temperature Conditions:

The equipment shall be capable of storage at temperatures from -65°F to +160°F. Efforts will be made to provide for reasonable operation over an ambient temperature range of 15°F to 120°F. It is known that optimum operation will not be attainable over this range. The main problems will be reduced battery output at low temperatures, change in galvanometer modulator damping with temperature, and variations in transistor parameters.

5. Vibration Tests:

The equipment shall withstand vibration testing from 5 to 55 cps at .060" total excursion for 1/2 hour in each of three principal planes.

6. Additional Requirements:

Where applicable and reasonable the requirements of specification MIL-E-16400(SHIPS) dated 1 May 1953 will be followed. This applies especially to materials and finishes.

Technical Study.

1. General equipment characteristics:

In order to obtain empirical data on several operational characteristics of the proposed communicator, a breadboard optical unit is being made. Most of the parts for this have been completed, and it is expected that it will be ready for testing by January 10. With this unit it is proposed to evaluate simultaneous operation of receiver and transmitter as an aid in "find" and alignment procedures. Push-to-talk control of the lamp will be tested and general requirements as to operating controls will be checked.

The breadboard optical unit will be used in conjunction with an amplifier unit which has been assembled. The amplifiers, employing vacuum tubes, are for use only with the breadboard. Transistor amplifiers will be designed and developed later. In the optical breadboard no attempt has been made to miniaturize the layout. Rather, it is considered more important that it be versatile and readily adaptable to modification.

2. Optical system:

The breadboard will use 1-1/2" diameter, 1-1/2" focal length lens systems similar to those of Model D for the objectives. Separate systems will be used for receiver and transmitter. The 1-1/2" aperture lenses will be used for test purposes because of their availability. However, they will be stopped down with a mask to produce a 1" square aperture. The performance of the breadboard with these optics and various cells and lamps will be checked in operation with a Model B equipment. One of the Model B equipments that went through environmental testing is being repaired and will be used in this testing program.

The use of small optics with correspondingly short focal lengths will allow the use of a very small lamp. It appears that a focal length between 1 and 1-1/4 inches can be used. Several sample lamps of about 3/4 watt size and satisfactory brightness have been obtained with filament coil dimensions of about 0.016" x 0.040". Such a lamp used with a 1-1/8" focal length objective

would produce a .8 x 2.0 degree beam. It is believed that such a beam will be satisfactory for a non hand-held unit. This can be better evaluated with the use of the breadboard unit.

Two Mallory Type RM-12R mercury cells were tested in operation of a sample lamp. Two hours continuous operation were obtained the first day, about 1-2/3 hours the second, and one hour the third day. The tests were conducted at 75° F. In more realistic, intermittent, operation even longer battery life can be expected. Further tests will be conducted to determine more completely the battery life under various temperature and duty cycle conditions.

Midwestern Instruments has been contacted regarding a smaller galvanometer for use as a modulator. The size of the modulator used in the Model B equipment together with the relatively large magnet and pole piece required prevent its use in this design. In addition the audio power required to drive a mirror assembly that is larger than necessary would needlessly complicate output amplifier design requirements. It was thought that Midwestern's smaller Model 102 galvanometer could be suitably modified for this application and, accordingly, tentative specifications were submitted.

To accommodate the larger window that would be required Midwestern recommended a unit in which the suspension system and lower part of the barrel are similar to their Model 102 while the window and upper section of the barrel are similar to that supplied to us for the Model B equipment. This would allow use of the large window without weakening the barrels as would otherwise result if the regular Model 102 barrel were modified. The new galvanometer would be about 2-5/16" long or little more than three quarters the length of the one used in Model B. The new magnet structure required will be correspondingly smaller than that of Model B. The galvanometer current sensitivity is estimated to be approximately 2.5 times better than the old one because of the smaller moving structure; the mirror size would be .020" x .090".

3. Amplifiers:

Transistor amplifiers are being studied and several breadboards have been built. Present information on the galvanometer modulator indicates that about 75 to 90 mw of audio power will be required for 100% modulation. A push-pull class B output stage (common emitter) with single class A driver has been built which delivers about 90 mw output. A quiescent current

of about 3 ma and a maximum signal current of 28 ma are required from a 6V battery.

It appears that a single stage ahead of the driver can be used either as the microphone preamplifier or the tone oscillator. A parallel "T" rejection filter applied in a negative feedback path around the preamplifier will give the necessary rising high frequency response for maximum speech intelligibility.

Some study of the receiver amplifier has been made. It seems quite certain that with the receiver low-noise transistors now available the first stage as well as the others can employ transistors. It will be necessary to transformer couple the cell to the first stage for efficient power transfer. Tests indicate that a four stage RC coupled transistor amplifier will give the necessary performance for the receiver. A noise of less than 10 microvolts referred to the input has been achieved. Power requirements were about 2.5 volts at 3 ma.

PROGRAM FOR NEXT INTERNAL:

The optical breadboard unit will be assembled and tests will be made with the vacuum range optical attenuator to determine the effectiveness of the one inch square optics. Initially a 1 x 1 mm Kodak Ektron lead sulfide cell will be used and a lamp requiring about 3/4 watt will be employed. Range determinations will be made of the breadboard unit operating against a Model B equipment. Further tests will be made to evaluate the performance of simultaneous receiver and transmitter operation in the "find" procedure.

Based on the information gained in this study and planning phase, more definite specifications will be set regarding the components and characteristics to be incorporated in the design approval models. Toward this end a study phase conference will be held with customer technical representatives. This conference is tentatively scheduled for some time in the week of 23 January 1956.

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Report prepared by:

Report approved by: